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Comparison of the effectiveness of application of GAMs for landslide susceptibility modelling in Apennine and Alpine areas

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The aim of this study is to contribute to the introduction of a benchmark dataset for landslide susceptibility. The contribution consists in the application of Generalized Additive Models (GAMs) on the test area proposed by Alvioli et al. (2022), located in Central Italy (Umbria Region, 4095 km²), and over the Mountain Communities of Mont Cervin and Mont Emilius (670 km²), located in the central part of Valle d'Aosta Region. In the latter, previous studies regarding landslide susceptibility were carried out by Camera et al. (2021) and Bajni (2022).

The susceptibility analysis is based on slope units for both areas and it uses the open-source dataset available for Italy (<https://geomorphology.irpi.cnr.it/tools/slope-units>, Alvioli et al., 2020). For Central Italy, predictors and response variable are those made available by Alvioli et al. (2022). For consistency, for Valle d'Aosta morphometric variables were calculated from the EUDEM digital elevation model (Copernicus Land Monitoring Service, 25 m horizontal resolution), while soil-related variables – namely soil depth, soil bulk density and particle size fractions – were derived from the SoilGrid global dataset (Hengl et al. 2017). In addition, coherently with Alvioli et al. (2022), two presence/absence landslide response variables ('1'/'0') were defined. For the first one, 'presence1', a slope unit was considered impacted by landslides ('1') if at least an event was recorded within its limits. For the second one, 'presence2', a slope unit was considered impacted by landslides ('1') if two or more landslides occurred within its limits. For Valle d'Aosta, landslide events were accessed through the regional inventory (<http://catastodissesti.partout.it/>), which is updated continuously by the Regional Civil Protection Department and the Forest Corps through regular surveys or following warnings from citizens.

Two landslide susceptibility maps were calculated for each area ('presence1', 'presence2'). GAMs were applied through the *mgcv* library of R, with and without the option of variable selection through shrinkage. In addition, predictors behavior was analyzed through the associated Component Smoothing Functions (CSF) to check for physical plausibility. Finally, to evaluate uncertainties, a non-spatial k-fold cross-validation was carried out and a model evaluation was performed based on contingency tables, area under the receiver operating characteristic curve (AUROC) and variable importance (decrease in explained variance).

By the application of the same modelling algorithm (GAM) with an input dataset derived from the same data sources, the study is expected to verify the consistency of the obtained landslide susceptibility results in terms of both model performance and main driving processes (predictors).

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